

A Computational Approach to Aspectual Composition

Une perspective computationnelle sur la composition aspectuelle

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Abstract

In this paper, I argue, contrary to the prevailing opinion in the linguistics and philosophy literature, that a sortal approach to aspectual composition can indeed be explanatory. In support of this view, I develop a synthesis of competing proposals by Hinrichs, Krifka and Jackendoff which takes Jackendoff's cross-cutting sortal distinctions as its point of departure. To show that the account is well-suited for computational purposes, I also sketch an implemented calculus of eventualities which yields many of the desired inferences. Further details on both the model-theoretic semantics and the implementation can be found in [26].

Dans cet article, je propose, contrairement aux opinions prépondérantes dans la littérature linguistique et philosophique, qu'une théorie "sortale" de la composition aspectuelle peut être explicative. Comme justification de cette thèse, je développe une synthèse des théories en compétition de Hinrichs, de Krifka et de Jackendoff, qui prend comme point de départ les distinctions sortales multi-dimensionnelles de Jackendoff. Afin de montrer que la solution présentée peut être exploitée computationnellement, j'esquisse un calcul d'éventualité's implémenté qui permet de faire beaucoup des inférences désirées. Des détails supplémentaires sur la sémantique à base de modèles et sur l'implémentation peuvent être trouvés dans [26].

*Most of this research was undertaken at the University of Pennsylvania, where the author was partially supported by an NSF Graduate Fellowship. For helpful comments and discussion, the author thanks Mark Steedman, Richard Oehrle, Alessandro Zucchi, Barbara Di Eugenio, Matthew Stone, Christine Doran, Owen Rambow and two anonymous reviewers.

1 Introduction

In recent years, it has become common in the linguistics and philosophy literature to assume that **events** and **processes** are ontologically distinct entities, on a par with **objects** and **substances**. At the same time, the idea that episodic knowledge should be represented as a collection of interrelated **eventualities** has gained increasing acceptance in the computational linguistics and artificial intelligence literature.

Contrary to what one might expect, a search through the prior literature in linguistics and philosophy reveals no account in which these sortal distinctions play a direct role in adequately explaining the problem of **aspectual composition** [4, 21]. In fact, amongst those that have explicitly considered this question, the consensus appears to be that no such explanation is likely to be found [13, 15, 22]. From a computational perspective this is rather unfortunate, since such distinctions have otherwise proved quite useful [3, 7, 9, 14].

In this paper, I set out to show that a sortal approach to aspectual composition, developed in the spirit of the eventuality-based work on episodic representation, can indeed be explanatory. In so doing, I develop a synthesis of competing proposals by Hinrichs [8], Krifka [13] and Jackendoff [10] which takes Jackendoff’s cross-cutting sortal distinctions as its point of departure. To show that the account is well-suited for computational purposes, I also sketch an implemented calculus of eventualities which yields many of the desired inferences. Further details on both the model-theoretic semantics and the implementation can be found in [26].

2 Motivation

From a knowledge-representation perspective, eventuality-based representations have proven to be convenient for their conciseness, support for underspecificity, and easy integration with natural language interfaces. For example, consider the following attribute-value representation of a *filling* event e_0 (the representations in this section are meant to be reminiscent of the ones in Dale [3], which are in turn based largely upon Bach [1]):

$$\left[\begin{array}{l} \text{index : } e_0 \\ \text{sort : event} \\ \text{pred : fill} \\ \text{agent : jack} \\ \text{patient : } \left[\begin{array}{l} \text{index : } x_0 \\ \text{sort : object} \\ \text{pred : bucket} \\ \text{card : 5} \end{array} \right] \\ \text{duration : } \left[\begin{array}{l} \text{number : 20} \\ \text{unit : minutes} \end{array} \right] \end{array} \right]$$

Jack filled five buckets in twenty minutes

It should be evident that this structure can be straightforwardly translated into the

English sentence *Jack filled five buckets in twenty minutes*.¹ To see that this representation is also concise, note that one can also derive numerous other sentences from this structure, given appropriate rules of inference: for example, *Jack filled a bucket*, *Jack filled something*, etc. On the other hand, this representation also supports underspecificity, since from this structure one cannot determine which five buckets were filled (e.g., bucket A, . . . , bucket E).

As a second example, let us now consider the following representation of a *pouring* process e_1 :

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : process} \\ \text{pred : pour} \\ \text{agent : jack} \\ \text{patient : } \left[\begin{array}{l} \text{index : } x_1 \\ \text{sort : substance} \\ \text{pred : water} \end{array} \right] \\ \text{goal : } \left[\begin{array}{l} \text{index : } x_a \\ \text{sort : object} \\ \text{pred : bucket} \\ \text{name : A} \end{array} \right] \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

Jack poured water into bucket A for thirty seconds

It should be evident once again that this structure can be straightforwardly translated into the English sentence *Jack poured water into bucket A for thirty seconds*. Moreover, this representation is similarly concise: given appropriate rules of inference, one can also derive *Jack poured water into bucket A for twenty-five seconds*, *Jack poured water into bucket A for twenty seconds*, and so forth.² Finally, this representation likewise supports underspecificity, since in the absence of any information about the rate of transfer one cannot determine how much water was poured into bucket A.

As the careful reader may have noticed, the choice of temporal adverbial in the preceding examples is conditioned by the sort of eventuality in question, which again depends on the verb. This is not the whole story, however: given a particular amount of water in the second example, the appropriate adverbial changes (cf. *Jack poured five gallons of water into bucket A *for/in thirty seconds*); contrariwise, switching to a bare plural in the first example, we may note a switch in the opposite direction (cf. *Jack filled buckets for/*in twenty minutes*). Adequately explaining dependencies such as these is the problem of **aspectual composition**, to which we now turn.

¹For simplicity I shall ignore the encoding of tense in this paper.

²While these sentences are clearly not as informative, this is a matter of implicature; to see this, contrast these sentences with their counterparts in the previous case (i.e., *Jack filled five buckets in fifteen/ten/. . . minutes*), which need not be true.

3 A Sortal Approach to Aspectual Composition

To make the ensuing discussion more concrete, let us examine the following possible representation for the sentence *Jack poured five gallons of water into bucket A in thirty seconds* (as in the previous section, this representation is meant to be reminiscent of those found in [3]):

$$\left[\begin{array}{l} \text{index : } e_1' \\ \text{sort : event} \\ \text{pred : pour} \\ \text{agent : jack} \\ \text{patient : } \left[\begin{array}{l} \text{index : } x_1' \\ \text{sort : object} \\ \text{pred : water} \\ \text{quantity : } \left[\begin{array}{l} \text{number : 5} \\ \text{unit : gallons} \end{array} \right] \end{array} \right] \\ \text{goal : } \left[\begin{array}{l} \text{index : } x_a \\ \text{sort : object} \\ \text{pred : bucket} \\ \text{name : A} \end{array} \right] \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

Jack poured five gallons of water into bucket A in thirty seconds

Comparing this representation to the previous one (for *Jack poured water into bucket A for thirty seconds*), two questions naturally arise:

- Why has e_1 changed to e_1' ? (And x_1 to x_1' ?)
- Assuming this has something to do with their differing sortal values, why should the the sort of e_1' depend upon that of x_1' in the first place?

Remarking on a question similar to the first one (and translating their remarks into the present context), Oberlander and Dale [16] observe that the primed and unprimed entities cannot be the same, since their respective sorts are assumed to be disjoint. They then suggest that this is in some sense to be expected, asserting that the two sentences these representations give rise to convey different *perspectives* on the same situation; at the same time though, they also acknowledge that at some level we would like to tie these two (supposed) perspectives together.

Interestingly, a similar problem arises with Jackendoff's [10] conception of the binary feature $\pm\mathbf{b(ounded)}$, which he introduces to distinguish both events (+b) from processes (−b) and objects (+b) from substances (−b). According to Jackendoff, “a speaker uses a −b constituent to refer to an entity whose boundaries are not in view or not of concern; one can think of the boundaries as outside the current field of view.” Although this idea has some appeal when one focuses on the discourse-backgrounding function that

atelic sentences can have, it does not seem particularly apt here, where our view of what has taken place remains constant.

While our two example sentences clearly convey different information, it is not at all obvious how to make sense of this difference in terms of perspectives. For this reason, I will pursue an alternative approach below which obviates the need to do so. As we shall see, this will require us to develop an alternative conception of the event/process (and object/substance) distinction than Jackendoff appears to have in mind.

Turning now to the second question, we should first note that *Jack poured water into bucket A* and *Jack filled bucket A with water* exhibit different aspectual behavior, despite the presence of the same mass noun. According to traditional wisdom, the relevant difference between *fill* and *pour* is that only the former encodes what Krifka [13] calls a **set terminal point**: if an event e is a filling event, then (presumably) no proper part of e is also a filling event, and thus *fill* is taken to encode a set terminal point; since this argument does not (presumably) go through for pouring events, *pour* is not taken to encode a set terminal point. Of course, while *pour* itself does not supply a set terminal point, one may be supplied indirectly by specifying a fixed quantity of what is poured; in this case, the terminal point coincides with the eventual exhaustion of this quantity.

As Krifka points out, the conventional wisdom about aspectual composition does not appear to be compatible with a sortal approach:

For consider a concrete event of running and a concrete event of running a mile; then surely both events have a terminal point (both events might even be identical). The difference is that an event of running might be part of another event of running which has a later terminal point, whereas this is not possible for an event of running a mile.

For this reason, Krifka [13] eschews sortal distinctions (amongst eventualities) and develops an account based upon the reference properties of event predicates instead. Unfortunately though, this decision leads to empirical problems with **non-individuating accomplishment expressions**, such as *run more than a mile* ([26]; cf. also Verkuyl [22]): grammatically, *run more than a mile* patterns with *run a mile*, yet according to Krifka's test, *run more than a mile* patterns with *run* (note that an event of running more than a mile might be part of another event of running more than a mile).

What Krifka's observation suggests is that in pursuing a sortal approach, we should look for alternatives to the sortal distinctions assumed so far, which are based upon Bach [1]. One possibility is to assume that substances and processes are more abstract entities than objects and events: for example, rather than letting a substance be a particular quantity of matter, we may assume a substance is a *continuum* of such quantities; likewise, we may take a process to be a continuum of events with differing durations.

To relate these continua to their particulars, I will borrow Jackendoff's **composed-of** relation (though not necessarily its original semantics). Following Jackendoff, I will assume that this relation forms part of the meaning of **measure phrases**, which include adjectival ones such as *five gallons of* and adverbial ones such as *for thirty seconds*.³

³Note that this term is not intended to include restrictive modifiers of measurement, such as *in*

This yields the following representations for our example sentences:⁴

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \\ \text{composed-of : } \left[\begin{array}{l} \text{index : } e \\ \text{sort : process} \\ \text{pred : pour} \\ \text{agent : jack} \\ \text{patient : } \left[\begin{array}{l} \text{index : } x \\ \text{sort : substance} \\ \text{pred : water} \end{array} \right] \\ \text{goal : } \left[\begin{array}{l} \text{index : } x_a \\ \text{sort : object} \\ \text{pred : bucket} \\ \text{name : A} \end{array} \right] \end{array} \right] \\ \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

Jack poured water into bucket A for thirty seconds

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \text{pred : pour} \\ \text{agent : jack} \\ \\ \text{patient : } \left[\begin{array}{l} \text{index : } x_1 \\ \text{sort : object} \\ \text{composed-of : } \left[\begin{array}{l} \text{index : } x \\ \text{sort : substance} \\ \text{pred : water} \end{array} \right] \\ \text{quantity : } \left[\begin{array}{l} \text{number : 5} \\ \text{unit : gallons} \end{array} \right] \end{array} \right] \\ \\ \text{goal : } \left[\begin{array}{l} \text{index : } x_a \\ \text{sort : object} \\ \text{pred : bucket} \\ \text{name : A} \end{array} \right] \\ \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

Jack poured five gallons of water into bucket A in thirty seconds

To paraphrase, in the first case e_1 is an event of duration thirty seconds which is composed of a process e in which Jack pours the substance x , which is water, into bucket A. In the second case, e_1 is instead an event (again of duration thirty seconds)

thirty seconds or *(a) five-gallon (X)*; although this choice of terminology appears to be consistent with that of Moltmann [15], perhaps a happier term could be found.

⁴NB: These representations are not the same as those found in [26], where a more standard logical representation is employed. For present purposes, this difference is assumed to be of no importance.

in which Jack pours the object x_1 into bucket A, where x_1 is a five-gallon quantity (composed-) of the substance x (which is again water).

At this point we may answer the two questions with which we began this section. With respect to the first question (is it necessary to introduce a new eventuality e_1' to represent the second of our two sentences?), the above representations show that we can now simply treat these two sentences as two different descriptions of the same event e_1 — much as in Krifka’s treatment — without causing a sortal clash.

Returning now to the second question (why should we observe sortal dependencies in the first place?), let us consider how the conventional wisdom can be reconstructed here. In [26], I suggest that the relation established by *pour* between a material entity and an eventuality is an instance of an **incremental thematic relation**, following the terminology of Dowty [6]. What characterizes such relations is how predication over continua is to be understood: predication should only involve **delimited** entities (e.g. various concrete objects) when the relevant participant remains constant across the continuum. For example, with our pouring process (e), the agent (Jack) and the goal (bucket A) remain constant across the particular events which make up the continuum. In contrast, the patient (varying quantities of water) does not remain constant; for this reason, a substance (x) must be used with the patient role in order to satisfy the above principle. As a corollary, note that if a particular quantity of water (e.g. x_1) is supplied for the patient role instead, process predication becomes impossible, which forces the predication to be over an event (e.g. e_1). While space precludes further discussion here, this brief sketch should indicate how the conventional wisdom concerning *set terminal points* can be realized along sortal lines.

To conclude this section, I shall briefly compare the present account to two other related ones. First, in its use of abstract entities (the continua) whose elements (or *realizations*) vary in amount, the present account is reminiscent of Hinrichs [8], where Carlsonian kinds are employed. In contrast to the present approach though, Hinrichs makes essentially no use of the sortal distinctions he proposes in the eventuality domain; moreover, unlike Krifka and Jackendoff, he does not propose a uniform treatment of adjectival and adverbial measure phrases.⁵ Second, the present account is also very much in the spirit of Verkuyl [22], especially in its attention to the problems posed by non-individuating accomplishment expressions. As the next section is intended to show, however, its sortal basis appears to make it better suited for computational purposes.

4 A Calculus of Eventualities

To illustrate how the present approach to aspectual composition maintains the conciseness advantage of eventuality-based knowledge representations cited previously, let us now consider two examples in some detail.

First, suppose our knowledge base contains the first representation of the event e_1 given near the end of the preceding section, repeated below:

⁵Yet another alternative would be to follow Hinrichs in his use of kinds in the nominal domain only, while abandoning his quantificational analysis of *for*-adverbials in favor of an analysis more in the spirit of Krifka’s approach. To successfully develop such an approach, however, requires several tricky issues concerning the scope of indefinites to be resolved. These issues are currently under investigation (in cooperation with Alessandro Zucchi).

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \\ \text{composed-of : } \left[\begin{array}{l} \text{index : } e \\ \text{sort : process} \\ \text{pred : pour} \\ \text{agent : jack} \\ \text{patient : } \left[\begin{array}{l} \text{index : } x \\ \text{sort : substance} \\ \text{pred : water} \end{array} \right] \\ \text{goal : } \left[\begin{array}{l} \text{index : } x_a \\ \text{sort : object} \\ \text{pred : bucket} \\ \text{name : A} \end{array} \right] \end{array} \right] \\ \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

Jack poured water into bucket A for thirty seconds

From this representation of e_1 , we should be able to derive the existence of an event e_2 in which Jack pours water into bucket A for twenty-five seconds, as well as an event e_3 in which he does so for twenty seconds, and so forth. This can be achieved using the following rule:

$$\left[\begin{array}{l} \text{index : } E_1 \\ \text{sort : event} \\ \text{composed-of : } E \\ \text{duration : } \left[\begin{array}{l} \text{number : } N_1 \\ \text{unit : } U \end{array} \right] \end{array} \right] \Rightarrow \left[\begin{array}{l} \text{index : } E_2 \\ \text{sort : event} \\ \text{composed-of : } E \\ \text{duration : } \left[\begin{array}{l} \text{number : } N_2 \\ \text{unit : } U \end{array} \right] \end{array} \right]$$

$E \text{ for } N_1 \text{ } Us$
 $E \text{ for } N_2 \text{ } Us$

where $N_2 \leq N_1$

This rule reflects a pair of assumptions regarding processes (i.e., process continua) such as e . First, it is assumed that the particular events making up the continuum e are closed under the subpart relation; thus, if the event e_1 composed-of e has a subevent e_2 , then e_2 must also be composed-of e . Second, if e_1 has duration N_1 Us , then for all non-negative numbers N_2 less than N_1 , e_1 is assumed to have a subevent e_2 of duration N_2 Us (clearly a simplifying assumption!). Taken together, these two assumptions yield the above rule as a theorem.

Second, let us now suppose that we have a method for calculating the rate of transfer for the pouring process e above, and that this rate multiplied by thirty seconds turns out to be five gallons. Using this information, we should then be able to derive the second representation of the event e_1 given near the end of the preceding section (repeated below) from the first one.

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \text{pred : pour} \\ \text{agent : jack} \\ \text{patient : } \left[\begin{array}{l} \text{index : } x_1 \\ \text{sort : object} \\ \text{composed-of : } \left[\begin{array}{l} \text{index : } x \\ \text{sort : substance} \\ \text{pred : water} \end{array} \right] \\ \text{quantity : } \left[\begin{array}{l} \text{number : 5} \\ \text{unit : gallons} \end{array} \right] \end{array} \right] \\ \text{goal : } \left[\begin{array}{l} \text{index : } x_a \\ \text{sort : object} \\ \text{pred : bucket} \\ \text{name : A} \end{array} \right] \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

Jack poured five gallons of water into bucket A in thirty seconds

This can be achieved using the following rule:

$$\left[\begin{array}{l} \text{index : } E_1 \\ \text{sort : event} \\ \text{composed-of : } \left[\begin{array}{l} \text{index : } E \\ \text{sort : process} \\ \text{pred : pour} \\ \text{agent : } A \\ \text{patient : } X \\ \text{goal : } G \end{array} \right] \\ \text{duration : } \left[\begin{array}{l} \text{number : } N_1 \\ \text{unit : } U_1 \end{array} \right] \end{array} \right] \Rightarrow \left[\begin{array}{l} \text{index : } E_1 \\ \text{sort : event} \\ \text{pred : pour} \\ \text{agent : } A \\ \text{patient : } \left[\begin{array}{l} \text{index : } X_1 \\ \text{sort : object} \\ \text{composed-of : } X \\ \text{quantity : } \left[\begin{array}{l} \text{number : } N_2 \\ \text{unit : } U_2 \end{array} \right] \end{array} \right] \\ \text{goal : } G \\ \text{duration : } \left[\begin{array}{l} \text{number : } N_1 \\ \text{unit : } U_1 \end{array} \right] \end{array} \right]$$

A pours X into G for N₁ U₁s

A pours N₂ U₂s of X into G in N₁ U₁s

where $N_2 = \text{rate}(E, U_2, U_1) \times N_1$

Since this rule may look overly complicated at first glance, let us pause to consider why it makes sense. Because the process E of which the event E_1 is composed is understood to be a continuum of pouring events, all with agent A and goal G , we can derive that E_1 in particular is a pouring event with agent A and goal G . As for the patient of E_1 , we may note that since the patient of E is understood to be the continuum X of quantities poured, one of these must be the patient of E_1 ; supposing that its index is X_1 , we can then derive that X_1 is both the patient of E_1 and composed of X . (The calculation of X_1 's amount, N_2 U_2 s, is not of particular concern here, and thus is assumed to be straightforward.)

In the actual implementation, this rule has been generalized to handle other verbs which form incremental thematic relations, such as *dribble*, *drip*, *leak*, *ooze*, *seep*, *siphon* and so on. Several additional cases have also been implemented, including the progressive, *at*-adverbials and the aspectual verbs *start*, *stop* and *finish*. These rules are described in detail in [26].

5 Space and Time Linked

The present account extends naturally to cover motion verbs, which are assumed to form incremental thematic relations between paths and eventualities (rather than between material entities and eventualities). For the most part, all that is required is to introduce the appropriate counterparts of the substances and processes into the domain of directed spatial entities.

Following Krifka, I will assume that events of directed motion have spatial traces as well as temporal ones, i.e., that each directed motion event has a unique (delimited) path and time interval associated with it. With directed motion processes, however, this cannot be the case, given the present conception of predication over continua: while a continuum of motion events may have the same agent and the same manner of motion, the path traversed does not remain constant. Consequently, if a directed motion process is to have a unique path associated with it, the path must likewise be a continuum, i.e. what I shall call a **non-delimited path**.

Once the notion of incremental thematic relation has been extended to the case of directed motion eventualities in this way, it remains only to examine the sortal restrictions which make sense for various path predicates. For example, with *to*-phrases (e.g. *to the bridge*), which specify endpoints, we may naturally assume that their translations are only well-sorted with delimited paths, since endpoints do not remain constant across a continuum of such paths. As a result, expressions such as *Jack run to the bridge* will give rise to predicates restricted to events, in contrast to *Jack run* (which can apply to processes as well). This explains why **Jack ran to the bridge for thirty seconds* is not well-formed, as illustrated below (recall that the composed-of relation serves to map processes to events):

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \\ * \text{ composed-of : } \left[\begin{array}{l} \text{index : } e \\ \text{sort : event} \\ \text{pred : run} \\ \text{agent : jack} \\ \\ \text{path : } \left[\begin{array}{l} \text{index : } p \\ \text{sort : delimited-path} \\ \text{pred : to} \\ \text{ref-obj : } \left[\begin{array}{l} \text{index : } b \\ \text{pred : bridge} \end{array} \right] \end{array} \right] \end{array} \right] \\ \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

** Jack ran to the bridge for thirty seconds*

Unlike *to*-phrases, *towards*-phrases do make sense for non-delimited paths, since these specify direction rather than endpoints (and direction can remain constant across a continuum). As such, *Jack ran towards the bridge for thirty seconds* receives the following well-formed translation:

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \\ \text{composed-of : } \left[\begin{array}{l} \text{index : } e \\ \text{sort : process} \\ \text{pred : run} \\ \text{agent : jack} \\ \\ \text{path : } \left[\begin{array}{l} \text{index : } p \\ \text{sort : non-delimited-path} \\ \text{pred : towards} \\ \text{ref-obj : } \left[\begin{array}{l} \text{index : } b \\ \text{pred : bridge} \end{array} \right] \end{array} \right] \end{array} \right] \\ \\ \text{duration : } \left[\begin{array}{l} \text{number : 30} \\ \text{unit : seconds} \end{array} \right] \end{array} \right]$$

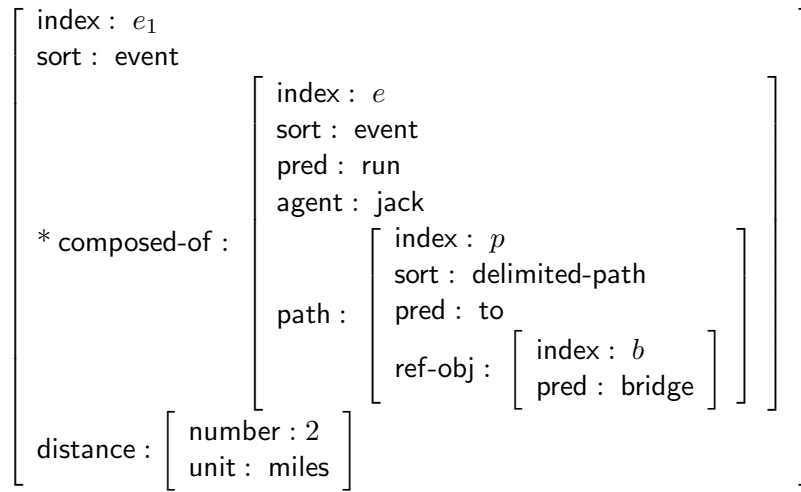
Jack ran towards the bridge for thirty seconds

As an aside, it is worth observing that non-delimited paths need not be *unbounded*. This is especially important with predicates such as **towards**, since the reference object here serves to impose an upper limit on how far the continuum can extend. For example, consider the process e above of Jack running towards the bridge (assumed to be of more or less constant speed and direction). Although the continuum e may contain events larger than e_1 , it cannot contain any events larger than the event in which Jack reaches the bridge, as the path of any such event would no longer satisfy the predicated yielded by *towards the bridge*. Because the present notion of delimitedness is independent of

boundedness (in the mathematical sense), the presence of upper bounds in cases such as this one is entirely unproblematic.

Another interesting case is that of *along*. In general, distance cannot be predicated of a non-delimited path, as distance varies according to the endpoints. This is not the case, however, with **proximal distance**, i.e. the distance between the path and the reference object, which can remain constant across a path continuum. This explains why sentences like *Jack ran along the river, two hundred yards from the shore, for thirty seconds* should be well-formed.

Finally we turn to distance phrases. As mentioned above, distance cannot be sensibly predicated of non-delimited paths, so I will assume that distance predication is restricted to delimited paths. Consequently, bare distance phrases will behave just like *to*-PPs, which explains both why *Jack ran two miles to the bridge* is fine and why **Jack ran two miles for ten minutes* is out. Now, what about distance phrases headed by *for*? Remarkably, these adverbials have been almost completely ignored in the literature. As with their temporal counterparts, I will assume that distance *for*-adverbials form measure phrases, i.e. serve to introduce the composed-of mapping. By making this natural assumption, we may then explain the curious fact that **Jack ran to the bridge for two miles* is horrible, in sharp contrast to both *Jack ran two miles to the bridge* and *Jack ran along the river for two miles*. This is illustrated below:



** Jack ran to the bridge for two miles*

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \text{pred : run} \\ \text{agent : jack} \\ \text{path : } \left[\begin{array}{l} \text{index : } p_1 \\ \text{sort : delimited-path} \\ \text{pred : to} \\ \text{ref-obj : } \left[\begin{array}{l} \text{index : } b \\ \text{pred : bridge} \end{array} \right] \end{array} \right] \\ \text{distance : } \left[\begin{array}{l} \text{number : 2} \\ \text{unit : miles} \end{array} \right] \end{array} \right]$$

Jack ran two miles to the bridge

$$\left[\begin{array}{l} \text{index : } e_1 \\ \text{sort : event} \\ \text{composed-of : } \left[\begin{array}{l} \text{index : } e \\ \text{sort : process} \\ \text{pred : run} \\ \text{agent : jack} \\ \text{path : } \left[\begin{array}{l} \text{index : } p \\ \text{sort : non-delimited-path} \\ \text{pred : along} \\ \text{ref-obj : } \left[\begin{array}{l} \text{index : } r \\ \text{pred : river} \end{array} \right] \end{array} \right] \end{array} \right] \\ \text{distance : } \left[\begin{array}{l} \text{number : 2} \\ \text{unit : miles} \end{array} \right] \end{array} \right]$$

Jack ran along the river for two miles

One consequence of the present approach is that *Jack run along the river for two miles* and *Jack run two miles along the river* are assigned rather different representations. Although space precludes further discussion here, this should not be considered particularly troublesome since these sentences can easily be made to be mutually entailing.

6 Conclusion

In this paper, I have argued that a sortal approach to aspectual composition, developed in the spirit of the eventuality-based work on episodic representation, can indeed be explanatory. In so doing, I have argued against the prevailing opinion in the linguistics and philosophy literature that such approaches inherently represent a dead end. In support of this view, I have developed a synthesis of competing proposals by Hinrichs [8], Krifka [13] and Jackendoff [10] which takes Jackendoff's cross-cutting sortal distinctions as its point of departure (cf. [26] for further details). Nevertheless, many other possible

ways of implementing a sortal approach remain to be explored, as do many empirical issues, and thus the question of whether a sortal approach to aspectual composition is to be preferred is likely to remain open for some time.

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